UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte MASAKAZU FURUKAWA, YASUJI HIRAMATSU, and YASUTAKA ITO

Appeal 2007-3073
Application 09/462,067
Technology Center 1600

Decided: November 29, 2007

Before, DONALD E. ADAMS, DEMETRA J. MILLS, and ERIC B. GRIMES, *Administrative Patent Judges*.

MILLS, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134. The Examiner has rejected the claims for obviousness. We have jurisdiction under 35 U.S.C. § 6(b). We affirm.

Representative claims follow.

1. A ceramic heater comprising:

a disc-shaped ceramic substrate made of nitride ceramic or carbide ceramic,

a heating body formed on the surface of the disc-shaped ceramic substrate, and

a surface opposite the surface having the heating body being a heating surface.

3. The ceramic heater according to claim 1, wherein the heating body comprises a sintered body of metal particles.

4. The ceramic heater according to claim 1, wherein the heating body comprises metal particles and metal oxide.

5. The ceramic heater according to claim 3, wherein the metal particles are at least one of noble metal, lead, tungsten, molybdenum and nickel.

6. The ceramic heater according to claim 1, wherein the heating body is covered on its surface with a non-oxidizing metal layer.

7. The ceramic heater according to claim 1, wherein the heating body has an aspect ratio at a section of the heating body of about 10 to about 10,000.

29. The ceramic heater according to claim 4,
wherein the metal oxide is at least one of lead oxide, zinc oxide, silicon oxide, boron oxide, aluminum oxide, yttrium oxide and titanium oxide,
wherein the metal oxide is present in an amount more than about 0.1 weight percent of the metal particles, and
wherein the metal oxide is present in an amount less than about 10 weight percent of the metal particles.

30. The ceramic heater according to claim 4,
wherein the metal particles have an average particle size of about 0.1 to 100 μm, and wherein the metal particles are flaked-shaped particles or a mixture of spherical particles and flake-shaped particles.

31. The ceramic heater according to claim 4, wherein the heating body comprises tungsten, molybdenum, tungsten carbide or molybdenum carbide.

32. The ceramic heater according to claim 5, wherein the noble metal is at least one of gold, silver, platinum and palladium.

Reference Relied on by the Examiner

Matsumura	US 5,151,871	Sep. 29, 1992
Kimura	US 5,331,134	Jul. 19, 1994
Yoshida	US 6,080,970	Jun. 27, 2000
Kawanabe	US 6,133,557	Oct. 17, 2000
Okuda	US 4,804,823	Feb. 14, 1989
Kubota	US 5,643,483	Jul. 1, 1997

Grounds of Rejection

Claims 7 and 25 stand rejected under 35 U.S.C. § 112, second paragraph as being indefinite.

Claims 1, 3, 5, 26-28, 32 and 33 stand rejected under 35 U.S.C. § 103 as obvious over Matsumura in view of Kawanabe or Yoshida.

Claims 4, 6 and 29-31 stand rejected under 35 U.S.C. § 103 as obvious over Matsumura in view of Kawanabe or Yoshida in view of Okuda.

Claims 7 and 25 stand rejected under 35 U.S.C. § 103, Matsumura in view of Kawanabe or Yoshida in further view of Kubota or Kimura.

DISCUSSION

Background

The claimed invention "relates to a ceramic heater used for drying in the semiconductor industry, and more particularly to a ceramic heater facilitating temperature control, which is thin and light." (Specification 1.)

"Typical semiconductor products are manufactured by applying an etching resist onto a silicon wafer and then etching. . . . [A] photosensitive resin is applied on to the surface of the silicon wafer and is dried after the application. The resin coated silicon wafer is generally placed on a heater in order to dry the coating". (Specification 1.)

Indefiniteness

Claims 7 and 25 are rejected under 35 U.S.C. § 112, second paragraph as being indefinite. The Examiner argues that in claims 7 and 25 it is unclear what are compared elements for the claimed ratio. (Final Rejection 2.) The Examiner argues that the prior art uses the term "aspect ratio" to define the length/width as well as the length/thickness and that it is not clear how Appellants are using the term. (Answer 3.)

"The definiteness of the language employed must be analyzed—not in a vacuum, but always in light of the teachings of the prior art and of the particular application disclosure as it would be interpreted by one possessing the ordinary level of skill in the pertinent art." *In re Moore*, 439 F.2d 1232, 1235 (CCPA 1971). Appellants contend that the meaning of the term "aspect ratio" is sufficiently defined in the Specification and need not be recited in the claim. (App. Br. 8.) We agree. In the present case the Specification, page 13 defines "aspect ratio" as the "width of the heating body/thickness of the heating body". In our view, Appellants have provided a clear meaning of what is intended by the use of the term "aspect ratio." Furthermore, other references in the Specification refer to the thickness of

the ceramic substrate (Specification 10-12) and the width of the heating body (Specification 12).

Thus, we find that one of ordinary skill in the art upon reading the Specification would have understood the term "aspect ratio" to refer to the "width of the heating body/thickness of the heating body."

The indefiniteness rejection is reversed.

Obviousness I

Claims 1, 3, 5, 26-28, 32 and 33 stand rejected under 35 U.S.C. § 103 as obvious over Matsumura in view of Kawanabe or Yoshida. Appellants provide separate argument for individual claims 1, 3, 5, 26-28 and 32 in the Brief. 37 C.F.R. 41.37(c)(1)(vii). Therefore, we address each of these claims separately.

With respect to claim 1, the Examiner finds

> Matsumura et al shows a ceramic heater having a ceramic substrate (13) with a heating body (14) formed on the surface of the ceramic substrate and a surface opposite the surface having the heating body being a heating surface. However, Matsumura et al does not explicitly show that the ceramic substrate is a disc-shaped.

(Final Rejection 2.)

The heating body of Matsumura is made of chromium with an upper plate made of alumina or ceramics (Matsumura, col. 5, ll. 35-45).

The Examiner relies on Kawanabe or Yoshida as showing "a ceramic heater including a disc-shaped ceramic substrate made of aluminum nitride. It is taught that the aluminum nitride provides a high resistance to corrosion

while providing high heat resistance." (Final Rejection 3; Kawanabe, col. 4, ll. 3-21 and Fig 7(a, b); Yoshida, col. 4, l. 28-40 and Fig. 2.) Both Kawanabe and Yoshida disclose a disc-shaped ceramic heater. (Kawanabe, Fig. 7; Yoshida, Figs. 2-3.)

The Examiner concludes that in view of Kawanabe or Yoshida, "it would have been obvious to one of ordinary skill in the art to adapt Matsumura et al with a disc-shaped ceramic substrate to accommodate and to heat uniformly a semiconductor wafer which is usually in the form of a disc." (Final Rejection 3.)

We agree with the Examiner's analysis and reasoning and find that the Examiner has provided sufficient evidence to support a prima facie case of obviousness.

Appellants contend that, "Kawanabe and Yoshida disclose heaters wherein the heating body is embedded in the inside of the ceramic substrate." (App. Br. 11.) Appellants argue that when "the heating body is embedded in the substrate" the structure has a lower heating response time as compared to a ceramic heater coated on the substrate as claimed. (*Id.*)

Kawanabe discloses that AlN contained in the heating body "enhances binding to the aluminum nitride sintered body constituting the base body of the wafer holding member, thereby preventing the heating resistor from being separated from the base body and also preventing the heating resistor from being cracked." (Kawanabe, col. 5, ll. 60-65.) Yoshida describes the AlN as having "a high thermal conductivity" and a "high resistance against corrosion by corrosive gases", a "high resistance against plasma" and that it "is suitable for the material of the ceramic substrate." (Yoshida, col. 4, ll.

32-40.) Thus, the prior art teaches that AlN is a desirable material for use in ceramic heaters.

While we acknowledge that Kawanabe and Yoshida disclose a heating body embedded in the substrate, the Examiner, instead, relies on Matsumura not Kawanabe or Yoshida for knowledge in the art of a heating body formed or coated on the underside of an upper plate of alumina (Matsumura, col. 5, ll. 39-45). Thus, the prior art was aware of a heater made of a ceramic base of aluminum nitride (Kawanabe, col. 1, ll. 39-45; col. 4, ll. 3-21). The prior art was further aware of a heater with an upper plate made of alumina or ceramics having good insulation and thermal conductivity characteristics and a conductive film of chromium formed on the underside of the upper plate. (Matsumura, col. 5, ll. 34-45.) "[W]hen the question is whether a patent claiming the combination of elements of prior art is obvious" the relevant question is "whether the improvement is more than the predictable use of prior art elements according to their established functions." *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007). In the present case, one of ordinary skill in the art would have had a reason to substitute the AlN of the heater of Kawanabe and Yoshida for the alumina in the heater of Matsumura because Matsumura suggests that the heater base could be ceramic and Kawanabe and Yoshida teach that aluminum nitride is a suitable ceramic with good properties, such as high thermal conductivity and high corrosion resistance, for ceramic use. (Kawanabe, col. 1, ll. 39-45; col. 5, ll. 58-65; Yoshida, col. 4, ll. 32-40.) In addition, one of ordinary skill in the art would have had a reason to substitute a disc shaped heater as described in Kawanabe and Yoshida for a rectangular heating body of Matsumura, for its

capability "of producing uniform distribution of temperatures on all the area on the top surface to uniformly heat the wafer." (Yoshida, col. 2, ll. 6-10.)

Appellants argue that, "the rejection must establish why it would have been obvious to modify Matsumura (a) to make the heater elements of Matsumura disc-shaped, (b) to make the heater elements of Matsumura disc-shaped with the disc-shaped ceramic substrate of Matsumura being a nitride or carbide ceramic substrate, and (c) to have the heating body of Matsumura formed on the surface of the substrate opposite a heating surface." (Reply Br. 8.) Each of the answers to Appellants' questions have been provided by the cited references. Kawanabe and Yoshida suggest modification of a square shaped heating body to a disc-shaped heating body to provide heating uniformity. (Kawanabe, Fig 7; Yoshida col. 2, ll. 6-10 and Figs 2-3.) These references also cite the benefits of using an aluminum nitride substrate. (Kawanabe, col. 5, l. 58-65.) Finally, Matsumura itself describes a heating body formed on the surface of the substrate opposite a heating surface. (Matsumura, col. 5, ll. 32 to col. 6, l. 18.)

Appellants rely on a Declaration under 37 C.F.R. 1.132 of Yasutaka Ito showing different heating and cooling properties of a ceramic heater with the heating body coated on the surface (as claimed) as compared to the heating body embedded in the substrate such as that of Okuda. We are not persuaded by this evidence because the prior art cited by the Examiner discloses a heating body as claimed, Matsumura, which is coated on the surface of the substrate and not embedded in the substrate. Appellants fail to compare the heating body claimed with the closest prior art, the substrate having a

heating body coated on its surface taught by Matsumura. Appellants are reminded that when relying on comparative testing, they are under a duty to "compare [the] claimed invention with the closest prior art." *See*, *In re Burckel*, 592 F.2d 1175 (CCPA 1979); *In re Merchant*, 575 F.2d 865 (CCPA 1978); *Ex parte Beck*, 9 USPQ2d 2000 (BPAI 1987).

Appellants argue that Table 1 on page 36 of the Specification compares the claimed aluminum nitride substrate with that of alumina (comparative example 2) and evidences that the aluminum nitride substrate claimed provides a small temperature difference on the heating surface and a low response time. (Reply Br. 11.)

However, "[e]xpected beneficial results are evidence of obviousness of a claimed invention, just as unexpected results are evidence of unobviousness thereof." *In re Gershon*, 372 F.2d 535, 538 (CCPA 1967). In the present case both Kawanabe and Yoshida evidence the expected benefit of using a heater substrate of AlN for its high thermal conductivity and high corrosion resistance (Kawanabe col. 1, ll. 39-45; Yoshida, col. 4, ll. 32-40) in the manner claimed. Thus, one of ordinary skill in the art would have expected thermal stability in a heating resistor made of AlN in view of Kawanabe and Yoshida.

With respect to claim 3, Kawanabe discloses a sintered body of metal particles at col. 5, ll. 60-65. As to claim 5, see Kawanabe, col. 6, ll. 6-12 describing the incorporation of molybdenum in a ceramic heater. As to claim 26, Kawanabe and Yoshida disclose AlN as discussed herein. As to claims 27-28, Matsumura discloses a conductive film thickness of 0.1 to

100μm. (Matsumura, col. 5, ll. 42-47.) As to claim 32, Yoshida discloses platinum in a heating resistor (see Yoshida, col. 4, l. 43).

Therefore, we are not persuaded by Appellants' argument and the obviousness rejection of claims 1, 3, 5, 26-28, and 32 is affirmed. Claim 33 falls with claim 1.

Obviousness II

Claims 4, 6 and 29-31 stand rejected under 35 U.S.C. § 103 as obvious over Matsumura in view of Kawanabe or Yoshida in view of Okuda. We address each claim separately as Appellants have separately argued individual claims. 37 C.F.R. 41.37(c)(1)(vii).

The Examiner finds that Matsumura and Kawanabe or Yoshida disclose all the structure claimed except the heating body having metal particles and metal oxides.

With respect to claim 4, the Examiner relies on Okuda as showing

> a heating body having metal particles such as TiN or WC with metal oxides of aluminum, yttrium or magnesium. Okuda et al further teaches that the oxides can make up to 10% weight when provided with TiN or up to 40% by weight when provided with WC to adjust the resistance value and to improve the adhesion to the ceramic substrate.

(Final Rejection 3.)

The Examiner concludes

> it would have been obvious to one of ordinary skill in the art to adapt Matsumura et al, as modified by Kawanabe et al or Yoshida et al, with the heating body having the claimed metal particles and oxides to form a desired heating resistance while

> improving the adhesion of the heating body to the ceramic substrate.

(*Id.* at 3-4.)

We agree with the Examiner that the prior art discloses the desirability of making a heating body having metal particles and metal oxides. (Okuda, col. 5, ll. 50-56.) In making an obviousness determination over a combination of prior art references, it is important to identify a reason why persons of ordinary skill in the art would have attempted to make the claimed subject matter. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007). When making such a determination, the scope of the prior art and level of ordinary skill must be considered. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966).

In the present case, Okuda describes that "MgO acts as the sintering aid for titanium nitride (TiN) and promotes densification." (Okuda, col. 5, ll. 50-56.) "Accordingly, the change of the resistance by formation of voids or cracks is controlled, and as the result, a good linearity is obtain in the resistance temperature coefficient." (Okuda, col. 5, ll. 50-55.) Okuda further discloses "that in the heat generating resistor composed of tungsten carbide (WC) or titanium nitride (TiN)… the change of the resistance according to the temperature is substantially linear." (Okuda, col. 4, ll. 33-37.) Furthermore, when the heater comprises WC or TiN "the inrush current at the time of application of the voltage can be reduced and the current capacity of the control apparatus for the heater can be reduced." (Okuda, col. 3, l. 64 to col. 4, l. 12.) In addition when the resistance temperature

coefficient "is small, the temperature distribution is uniformalized in the heater irrespectively of the atmosphere where the heater is used." (Okuda, col. 4, ll. 6-16.) Therefore Okuda provides a reason why persons of ordinary skill in the art would have been motivated to substitute or use metal oxides and metal particles such as tungsten carbide in a heating body for a ceramic heater, as claimed.

Appellants argue that "Okuda does not overcome the deficiencies of Matsumura, Kawanabe and Yoshida." (Br. 18.) Appellants argue that Okuda describes "a quadrangle-shaped heater and not a disc-shaped heater, as recited in the present claims." (Br. 18.) Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references. *In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). The test of obviousness "is whether the teachings of the prior art, taken as a whole, would have made obvious the claimed invention." *In re Gorman*, 933 F.2d 982, 986 (Fed. Cir. 1991). The Examiner has provided evidence in the prior art of the benefits of using a disc-shaped heater for heating silicon wafers in Kawanabe and Yoshida. As discussed herein we have found no deficiencies in the combination of Matsumura with Kawanabe and Yoshida.

Appellants argue that the Examiner's rejection does not point to specific disclosure where Okuda teaches or suggests a mixture of a sintered body of metal particles and metal oxide and does not point to where Okuda teaches or suggests improving the adhesion of the heating body to the

ceramic substrate. (Br. 18-19.) However, Okuda, col. 5, ll. 50-52 states that MgO acts as a sintering aid for TiN and promotes densification. Okuda further describes a composition of "TiN and AlN tightly bonded to each other" without embrittlement or breaking of the resistor layer. (Okuda, col. 6, ll. 44-53.) In addition, the change in resistance by formation of voids or cracks is controlled and the result is a good linearity in the resistance temperature coefficient. Thus, Okuda provides a reason why one of ordinary skill in the art would have been motivated to use a metal oxide in combination with a metal in a sintered heating body. The motivation to combine references does not have to be identical to patent owner's to establish obviousness. *In re Kemps*, 97 F.3d 1427, 1430 (Fed. Cir. 1996).

With respect to claims 6 and 29-31 argued by Appellants in the Brief at pages 19-20, Okuda describes incorporating a non-oxidizing metal such Ni in the terminal attaching portion of the exposed portion of the heating body, as in claims 6 and 31. (Okuda, col. 7, ll. 11-23.) The Examiner concludes that it would have been obvious to one of ordinary skill in the art to have an non-oxidizing metal such as Ni on the exposed heating body such that when the electrical terminals are attached to the heating body it can be done without degradation if the heater is used over a long period of time. We agree.

With respect to claim 29, Okuda teaches a heating body of metal particles such as TiN or WC with metal oxides of aluminum, yttrium or magnesium. (Answer 3; Okuda, col. 7 and 8, Table 1.) Okuda teaches that the oxides can make up to 10% weight when provided with TiN or up to 40% by weight when provided with WC to adjust the resistance value and to

improve the adhesion to the ceramic substrate. (Okuda, col. 6, ll. 60 to col. 7, l. 4.) Okuda further describes incorporating a metal oxide such as aluminum oxide as a sintering additive in an amount of 1.9% or 4.1% by weight, as in claim 29. (Okuda, col. 8, ll. 13-15; Table 1.) As to claim 30, Kawanabe teaches a particle size of from 5 to 50 μm. (Kawanabe, col. 6, ll. 51-55.)

In view of the above, the obviousness rejection is affirmed.

Obviousness III

Claims 7 and 25 are rejected under 35 U.S.C. § 103, Matsumura in view of Kawanabe or Yoshida in further view of Kubota or Kimura. We select claim 7 as representative of this rejection.

The Examiner finds that Matsumura and Kawanabe or Yoshida disclose all the structure claimed except the claimed ratio.

The Examiner relies on Kubota or Kimura as showing that it is known in the art that

> the cross sectional of the heating body having the claimed ratio[ ] of 2000 and 180, respectively. In view of Kubota et a1 or Kimura et al, it would have been obvious to one of ordinary skill in the art to provide the ratio within the claimed range so that the heating body is set to a desired electrical resistance to generate the desire[d] heating temperature uniformly along the heating surface.

(Final Rejection 4.)

Appellants admit that Kubota teaches an aspect ratio of 2000 and Kimura discloses an aspect ratio of 380. (Br. 21.) Each of these aspect

ratios fall within the broad scope of aspect ratios claimed of 10 to 10,000. Thus both Kubota and Kimura evidence that the prior art disclosed acceptable aspect ratios of 380 and 2000. We conclude that it would have been obvious to one of ordinary skill in the art to select a known and acceptable aspect ratio for a ceramic heater in view of Kubota and Kimura.

The rejection for obviousness is affirmed.

SUMMARY

The indefiniteness rejection is reversed. The obviousness rejections are affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED

lp

OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, P.C.
1940 DUKE STREET
ALEXANDRIA VA 22314